REMARKS

Non-elected claims 1, 2, 5, 6, 20-22, 25 and 26 have been canceled. Claim 27 has been withdrawn as a non-elected method claim and has been amended to depend from claim 3. Accordingly, should base independent claim 3 be determined patentable during prosecution of the present application, Applicants respectfully request rejoinder of the dependent method claim.

Accordingly, claims 3, 4, 7, 8, 16-19, 23 and 24 are pending. Applicant submits arguments for overcoming the rejections based on the prior art of record and respectfully submits that the present application is in condition for allowance. Rejoinder of dependent method claim 27 is requested.

I. Claim Rejections – §103(a)

A. *In the Office Action, claims 3, 4, 7, 8, 16, 18, 19 and 23 are rejected under §103(a) as being obvious over JP 06-177128 A (published June 24, 1994).*

Applicants respectfully request reconsideration and removal of the above referenced rejection for the following reason.

Independent claims 3 and 7 of the present application are each directed to a copper alloy sputtering target and each require the following structural limitation:

Claim 3:

"said target having a ratio I(111)/I(200) of an X-ray diffraction peak intensity I(111) of a (111) face and an X-ray diffraction peak intensity I(200) of a (200) face of 2.2 or more in said sputtering face";

Claim 7:

"wherein a ratio I(111)/I(200) of an X-ray diffraction peak intensity I(111) of a (111) face and an X-ray diffraction peak intensity I(200) of a (200) face is 2.2 or more in said sputtering face".

On page 4 of the Office Action, it is acknowledged that "JP 06-177128 does not disclose the recited x-ray diffraction ratio". However, despite the failure of JP'128 to disclose or obviate this critical structural feature of the claimed copper alloy sputtering target, claims 3 and 7 of the present application are rejected for the following stated reason:

> "With respect to the instant claimed x-ray diffraction ratio that it is a material property which would have been inherently possessed by the material."

Applicants respectfully disagree with this statement and believe it to be false and an error. Applicants respectfully submit that when JP'128 is properly interpreted, the above discussed structural limitation required by claims 3 and 7 of the present application is neither taught, suggested nor disclosed by JP'128 and is certainly not "inherently possessed" by the material of JP'128.

This is best demonstrated by the disclosure of the present application, as filed. Page 6, lines 20-25, of the present application reads, as follows:

> "Further, upon manufacturing the target, after performing homogenization heat treatment with a certain degree of thickness, in the subsequent cooling step, it is important to sandwich this with metals having a large thermal capacity such as copper plates underwater, and to increase the cooling effect without generating a vapor layer on the surface thereof. This is because if a vapor layer is formed, the cooling effect will significantly deteriorate."

This process step also forms the final process step required by withdrawn claim 27 of the present application.

This cooling step is discussed with respect to the Examples and Comparative Examples described in the present application. Examples 2-1 and 2-2 and Comparative Examples 2-1 and 2-2 are directed to Cu-Al alloy sputtering targets (see page 7, line 27, to page 8, line 21). As disclosed on page 8, lines 2-5, Example 2-1 was prepared as follows:

"Thereafter, this was rolled until it became φ 360x10t with cold rolling, heat treatment was performed thereto at 500°C for 1 hour, and this was sandwiched with copper plates under water for forced cooling. Moreover, this was machined processed to obtain a discoid target having a diameter of 13 inches and a thickness of 7mm."

With respect to Example 2-2, the same process steps were utilized as for Example 2-1. With respect to Comparative Examples 2-1 and 2-2, all process steps are identical to that used for Example 2-1, except that underwater cooling was replaced by "cooling in a furnace." For example, see page 8, lines 14-22, which reads as follows:

"Comparative Example 2-1

Using the same materials as Example 2-1, after performing heat treatment at 500 degrees for 1 hour, this was cooled in a furnace. The other conditions were the same as Example 2-1. As a result, a copper alloy target containing 1.0wt% of Al was prepared.

Comparative Example 2-2

Using the same materials as Example 2-2, after performing heat treatment at 500 degrees for 1 hour, this was cooled in a furnace. The other conditions were the same as Example 2-2. As a result, a copper alloy target containing 0.5wt% of Al was prepared."

Accordingly, Example 2-1 and Comparative Example 2-1 of the present application are identical with the only exception being the process step of underwater cooling between plates versus the process step of cooling in a furnace. The same is true between Example 2-2 and Comparative Example 2-2.

On page 16, in Table 6, the present application reveals that the ratio I(111)/I(200) for Examples 2-1 and 2-2 are 2.64 and 2.25, respectively, which are both "2.2 or more" as required by claims 3 and 7 of the present application. However, Table 6 shows that the ratio I(111)/I(200) for the Comparative Examples are 1.73 and 1.21, respectively, which are both outside of the range "2.2 or more" and outside of the scope required by claims 3 and 7 of the present

application. Keep in mind, the only difference between the Examples and the Comparative Examples was the process step of underwater cooling between plates and cooling in a furnace.

Accordingly, Applicants respectfully submit that it is an error and it is inaccurate to conclude that: "With respect to the instant claimed x-ray diffraction ratio that it is a material property which would have been inherently possessed by the material." The ratio is not inherently possessed by the material. For at least this reason, Applicants respectfully request reconsideration and removal of the rejection of claims 3, 4, 7, 8, 16, 18, 19 and 23.

Further, it should be taken into account that JP'128 is directed to a sputtering target for forming copper wiring itself. Thus, the target is used in a sputtering operation to produce a thin film for purposes of providing copper wiring.

In contrast, the present invention is not directed to a sputtering target for use in forming copper wiring itself. Rather, according to the present invention, the copper wiring is formed by an electroplating process. The purpose of the copper alloy sputtering target of the present invention is to form a thin copper base layer (ie., seed layer) on a conductive barrier film formed on a substrate without aggregation. The electroplated wiring is then applied onto the seed layer.

Accordingly, the intended use of the target of JP'128 and the present application are different. While this may not be given patentable significance, it does provide evidence to why JP'128 does not render the invention described in claims 3 and 7 of the present application obvious. One of ordinary skill in the art would not look to JP'128 for a target for forming a seed layer, and one of ordinary skill in the art would have no common sense reason to utilize an underwater cooling step between plates in the production of the target of JP'128. Accordingly, JP'128 would not produce a target having the claimed ratio and structure, and it would not be obvious to one of ordinary skill in the art to arrive at the present invention based on JP '128.

Applicants respectfully request reconsideration and removal of the rejection of claims 3, 4, 7, 8, 16, 18, 19 and 23.

B. In the Office Action, claims 3, 4, 7, 8, 16-19, 23 and 24 are rejected under §103(a) as being obvious over JP 06-177128 A in view of U.S. Patent No. 6,451,135 B1 issued to Takahashi et al.

Applicants respectfully request reconsideration and removal of the above referenced rejection for the following reasons.

In the Office Action, it is acknowledged that JP '128 fails to disclose the x-ray diffraction ratio and grain size required by the claims of the present application. Accordingly, to make the above referenced rejection, the Office Action concludes that one of ordinary skill in the art would modify the target of JP '128 according to the target of the Takahashi et al. patent for the following reason:

> "... because the set forth benefits and function entail the motivation of one skill in the art to make a claimed sputtering target, in the expectation that compounds similar in structure would have similar properties."

The U.S. Board of Patent Appeals has consistently held that rejections on obviousness grounds cannot be sustained by mere conclusory statements. Instead, there must be articulate reasoning with rational underpinning to support the legal conclusion of obviousness.

Applicants respectfully submit that a proper *prima facie* case of obviousness cannot be made under 35 USC §103(a) with JP '178 in view of the Takahashi et al. patent because an adequate rationale has not been articulated for such a combination and modification. The above statement is a mere conclusory statement. One of ordinary skill in the art using common sense at the time of the invention would not have reasonably combined the teachings of JP '128 with that of the Takahashi et al. patent for the following reasons.

JP '128 is directed to a technology for forming, via sputtering, a thin film which itself provides copper wiring. JP '128 teaches that this thin film copper wiring must have superior oxidation resistance which is obtained by oxidizing an alloy added with a specific element. More specifically, JP'128 requires its copper alloy sputtering target to contain up to 20wt% of Al for the purpose of providing oxidation resistance.

In direct contrast, the Takahashi et al. patent relates to a technology for preventing an increase in electrical resistance by inhibiting impurity content of the copper target. Accordingly, Takahashi et al. teach that no significant amount of Al should be permitted in the copper sputtering target.

More specifically, the Takahashi et al. patent teaches to one of ordinary skill in the art that (see column 2, line 66, to column 3, line 52):

> "The high-purity copper sputtering target of this invention has an impurity content reduced to a minimum.
>
> In order to ensure the reliability of performance of a semiconductor device formed by sputtering, it is important to minimize the proportion of impurities deleterious to semiconductor devices. ...
>
> Besides these elements, particularly those harmful to semiconductor elements, other impurities must also be minimized. Generally, electric resistance is a function of the impurity level and the smaller the impurity content the lower the electric resistance. Thus, in order to lower the electric resistance, a higher purity is desirable. When the actual cost of producing a sputtering target and other considerations are taken into account, it would be of great practical value to control the impurity level so that the resulting thin film shows an electric resistance below 2.0 $\mu\Omega \cdot cm$.
>
> Thus not only the heavy metal elements but also such light metal elements as Al, Ca, Mg must be reduced in proportions, to 1 ppm or less, preferably 0.1 ppm or less, each."

Accordingly, Takahashi et al. disclose a high purity copper sputtering target without impurities and specifically define Al as an impurity. The content of Al is required to be less then 1ppm. In the Examples provided in Table 1 of Takahashi et al., each of the Examples and Comparative Examples includes no more then 0.05 ppm of Al. Further, Takahashi et al. specifically teach and require that the "films formed using the high-purity copper sputtering targets according to the invention had very low resistivities of no more than 2.0 μΩ·cm." (See column 7, lines 57-59, of Takahashi et al.)

Accordingly, Takahashi et al. teach away from the present invention (which requires 0.2 to 5wt% Al and a resistivity of 2.2 μΩ·cm or greater) and also teaches away from and provides a contradictory teaching relative to JP '128 (which requires up to 20wt% Al and a resistivity of as high as 10.0 μΩ·cm).

One of ordinary skill in the art is taught by Takahashi et al. not to include significant amounts (ie., no more then 1ppm) of Al so that a desired low resistivity (no more than 2.0 μΩ·cm) is attainable. In contrast, one of ordinary skill in the art is taught by JP '128 that up to 20wt% of Al must be included for purposes of providing oxidation resistance.

One of ordinary skill in the art would clearly ascertain that you cannot have both the low resistivity (required by Takahashi et al.) and high oxidation resistance (required by JP '128). Thus, it would not be obvious for one of ordinary skill in the art to modify JP '128 according to the contradictory teachings of Takahashi et al. patent. Further, one of ordinary skill in the art would consider the entire disclosures of each of JP '128 and the Takahashi et al. patent as a whole and would not be expected (relying only on ordinary and routine skill) to pick and choose which teachings to follow and which teachings to ignore. This would neither be routine nor ordinary.

Accordingly, Applicants respectfully submit that JP '128 and the Takahashi et al. patent provide contradictory teachings that would not be combined by one of ordinary skill in the art for the reasons discussed above.

Further, Applicants respectfully submit that the Takahashi et al. patent fails to disclose the crystal grain size required by claims 17 and 24 of the present application. In Table 2 of the Takahashi et al. patent, the grain size of the Examples of the Takahashi et al. invention range from 150 to 460μm, and none is as low as 50μm.

Film thickness uniformity of a film formed by sputtering depends upon the crystal grain size of the copper target. Since the crystal grain size of the copper target of the present invention is roughly 1/5 of the crystal grain size of the copper targets described in the Takahashi et al. patent, it is evident that film thickness uniformity of the film formed with the present invention is far superior to that of the Takahashi et al. patent. (For instance, compare Table 6 of the present application with respect to film thickness standard deviation of 1.3% and 1.4% for Cu-Al films relative to 1.5 to 2.3% for that disclosed in Table 3 of the Takahashi et al. patent. According to the present invention, crystal grain size in the range of 50 to 250μm is not tolerable. Thus, the present invention differs with the Takahashi et al. patent for this additional reason.

For these reasons, Applicants respectfully request reconsideration and removal of the rejection of claims 3, 4, 7, 8, 16-19 23 and 24.

II. Conclusion

In view of the above remarks, Applicants respectfully submit that the rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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